CLAIMS

1. A pressure vessel liner comprising a tubular trunk and two head plates for closing respective opposite end openings of the trunk, the liner being made from at least two liner components so shaped as to be obtained by dividing the trunk with respect to the longitudinal direction thereof, by joining the components,

each of the liner components being fixedly provided inside thereof with a reinforcing wall, the liner components corresponding to each other in the position of the reinforcing wall, the reinforcing walls of adjacent pair of liner components being joined to each other.

2. A pressure vessel liner according to claim 1 which is made from a first liner component comprising a tubular body having opposite open ends and providing the trunk, and two second liner components joined to respective opposite ends of the first liner component and providing the respective head plates, the first liner component being fixedly provided inside thereof with a reinforcing wall extending longitudinally thereof and dividing the inside thereof into a plurality of spaces having opposite open ends, each of the second liner components being fixedly provided inside thereof with a reinforcing wall corresponding to the reinforcing wall of the first liner component in position and dividing the inside thereof into a plurality of spaces each having one open end, the reinforcing wall of the first liner component being joined to the reinforcing wall of each second liner component.

3. A pressure vessel liner according to claim 1 which

is made from a first liner component in the form of a bottomed tubular body open at one end and closed at the other end and providing the trunk and one of the head plates, and a second liner component joined to the open end of the first liner component and providing the other head plate, the first liner component being fixedly provided inside thereof with a reinforcing wall extending longitudinally thereof and dividing the inside thereof into a plurality of spaces each having one open end, the second liner component being fixedly provided inside thereof with a reinforcing wall corresponding to the reinforcing wall of the first liner component in position and dividing the inside thereof into a plurality of spaces each having one open end, the reinforcing wall of the first liner component being joined to the reinforcing wall of the second liner component.

4. A pressure vessel liner according to claim 2 or 3 wherein the first liner component comprises a tubular peripheral wall, a first and a second reinforcing wall inwardly extending from the peripheral wall toward a center line and joined to each other on the center line, the first and second reinforcing walls being positioned in a plane, and a third and a fourth reinforcing wall inwardly extending from peripheral wall portions on opposite sides of the first and second reinforcing walls toward the center line and joined to the first and second reinforcing walls on the center line, the second liner component comprising a peripheral wall generally in the form of a bowl, and first to fourth reinforcing walls provided inside the peripheral wall and corresponding respectively to the first to fourth reinforcing walls of the first liner component,

an end of the peripheral wall of one of the first and second liner components being cut away at portions thereof between the first reinforcing wall and the third and fourth reinforcing walls to cause an end portion of one side face of each of the third and fourth reinforcing walls to project outward beyond the peripheral wall, an internally enlarged groove being formed in end faces of the first and second reinforcing walls and in an end face of the peripheral wall and extending in the end faces of the first and second reinforcing walls longitudinally of the end faces, the internally enlarged groove having opposite end openings in an outer surface of the peripheral wall, a furrow being formed in the side face of each of the third and fourth reinforcing walls projecting outward beyond the peripheral wall and in a stepped portion continuous with the projecting side face, the furrow extending widthwise of each of the third and fourth reinforcing walls to thereby provide an engaging portion,

an end of the peripheral wall of the other of the first and second liner components being cut away at portions thereof between the second reinforcing wall and the third and fourth reinforcing walls to cause an end portion of one side face of each of the third and fourth reinforcing walls to project outward beyond the peripheral wall, a fitting portion being provided on ends of the first and second reinforcing walls and on the end of the peripheral wall and being fittable into the internally enlarged groove of said one liner component, a joint portion of the peripheral wall and the first reinforcing wall and joint portions of the third and fourth reinforcing

walls and the first and second reinforcing walls being cut away except parts thereof identical in shape with the cross sectional shape of the fitting portion, a furrow being formed in the side face of each of the third and fourth reinforcing walls projecting outward beyond the peripheral wall and in a stepped portion continuous with the projecting side face, the furrow extending widthwise of each of the third and fourth reinforcing walls to thereby provide an engaging portion,

the fitting portion of said other liner component being fitted in the internally enlarged groove of said one liner component, the engaging portions of the two liner components being in engagement with each other.

5. A pressure vessel liner according to claim 4 wherein the two liner components are made of aluminum and joined to each other by friction agitation, electron beam welding, laser welding, MIG welding or TIG welding.

6. A pressure vessel liner according to claim 2 or 3 wherein the first liner component comprises a tubular peripheral wall and a plurality of reinforcing walls inwardly extending from the peripheral wall and joined to one another, an internally enlarged groove being formed in an end face of each of the reinforcing walls and in an end face of the peripheral wall and extending longitudinally of the end face of each reinforcing wall, the internally enlarged groove having an end opening in an outer surface of the peripheral wall,

the second liner component comprising a peripheral wall generally in the form of a bowl and a plurality of reinforcing walls provided inside the peripheral wall and corresponding

to the respective reinforcing walls of the first liner component, an internally enlarged groove being formed in an end face of each of the reinforcing walls and in an end face of the peripheral wall and extending longitudinally of the end face of each reinforcing wall, the internally enlarged groove having an end opening in an outer surface of the peripheral wall,

the peripheral wall and the reinforcing walls of the first liner component being butted against the peripheral wall and the reinforcing walls of the second liner component respectively end-to-end, a connecting member being fitted in each of the internally enlarged grooves of the first liner component and the internally enlarged groove of the second liner component opposed thereto across the butted end faces thereof.

7. A pressure vessel liner according to claim 6 wherein the two liner components and an outer end portion of the connecting member are made of aluminum, and the two liner components are joined to each other and the two liner components are joined to the outer end portion of the connecting member by friction agitation, electron beam welding, laser welding, MIG welding or TIG welding.

8. A pressure vessel liner according to claim 2 or 3 wherein the first liner component comprises a tubular peripheral wall, two reinforcing walls inwardly extending from the peripheral wall toward a center line and joined to each other on the center line, the two reinforcing walls being positioned in a plane, and at least one reinforcing wall inwardly extending from the peripheral wall and joined to the two reinforcing walls, the second liner component comprising a peripheral wall generally

in the form of a bowl, and a plurality of reinforcing walls provided inside the peripheral wall and corresponding respectively to the reinforcing walls of the first liner component,

one of the first and second liner components having an internally enlarged groove formed in end faces of the two reinforcing walls thereof positioned in the same plane and in an end face of the peripheral wall thereof, the internally enlarged groove extending in the end faces of the two reinforcing walls longitudinally of the end faces and having opposite end openings in an outer surface of the peripheral wall, the other of the first and second liner components having a fitting portion provided on ends of the two reinforcing walls thereof positioned in the same plane and on an end of the peripheral wall thereof and fittable into the internally enlarged groove of said one liner component,

the first and second liner components each having an internally enlarged groove formed in an end face of the other reinforcing wall thereof and in the end face of the peripheral wall thereof and extending in the end face of said other reinforcing wall longitudinally of the end face, the internally enlarged groove of said other reinforcing wall having an end opening in the outer surface of the peripheral wall,

the fitting portion of said other liner component being fitted in the internally enlarged groove in the two reinforcing walls of said one liner component positioned in the same plane and in the peripheral wall, the peripheral wall and the reinforcing walls of the first liner component being butted against the

peripheral wall and the reinforcing walls of the second liner component respectively end-to-end, a connecting member being fitted in the internally enlarged groove of said other reinforcing wall of the first liner component and of the peripheral wall thereof and in the internally enlarged groove of said other reinforcing wall of the second liner component and of the peripheral wall thereof across the butted end faces of the walls.

9. A pressure vessel liner according to claim 8 wherein the two liner components and an outer end portion of the connecting member are made of aluminum, and friction agitation joining, electron beam welding, laser welding, MIG welding or TIG welding is resorted to for joining the two liner components to each other, and joining the fitting portion and the outer end portion of the connecting member to peripheral wall portions providing outer end portions of inner peripheral surfaces defining the respective internally enlarged grooves from outside.

10. A process for fabricating a pressure vessel liner according to claim 4 comprising:

preparing a first liner component of aluminum comprising a tubular peripheral wall, a first and a second reinforcing wall inwardly extending from the peripheral wall toward a center line and joined to each other on the center line, the first and second reinforcing walls being positioned in a plane, and a third and a fourth reinforcing wall inwardly extending from peripheral wall portions on opposite sides of the first and second reinforcing walls toward the center line and joined

to the first and second reinforcing walls on the center line, and a second liner component of aluminum comprising a peripheral wall generally in the form of a bowl, and first to fourth reinforcing walls provided inside the peripheral wall and corresponding respectively to the first to fourth reinforcing walls of the first liner component,

cutting away portions of an end of the peripheral wall of one of the first and second liner components between the first reinforcing wall and the third and fourth reinforcing walls to cause an end portion of one side face of each of the third and fourth reinforcing walls to project outward beyond the peripheral wall, forming an internally enlarged groove in end faces of the first and second reinforcing walls of said one liner component and in an end face of the peripheral wall thereof, the internally enlarged groove extending in the end faces of the first and second reinforcing walls longitudinally of the end faces and having opposite end openings in an outer surface of the peripheral wall, and forming a furrow in the side face of each of the third and fourth reinforcing walls of said one liner component projecting outward beyond the peripheral wall and in a stepped portion continuous with the projecting side face to thereby provide an engaging portion, the furrow extending widthwise of each of the third and fourth reinforcing walls,

cutting away portions of an end of the peripheral wall of the other of the first and second liner components between the second reinforcing wall and the third and fourth reinforcing walls to cause an end portion of one side face of each of the

third and fourth reinforcing walls to project outward beyond the peripheral wall, providing a fitting portion on ends of the first and second reinforcing walls of said other liner component and on the end of the peripheral wall thereof, the fitting portion being fittable into the internally enlarged groove of said one liner component, cutting away a joint portion of the peripheral wall of said other liner component and the first reinforcing wall thereof and joint portions of the third and fourth reinforcing walls of said other liner component and the first and second reinforcing walls thereof except parts thereof identical in shape with the cross sectional shape of the fitting portion, and forming a furrow in the side face of each of the third and fourth reinforcing walls of said other liner component projecting outward beyond the peripheral wall thereof and in a stepped portion continuous with the projecting side face to thereby provide an engaging portion, the furrow extending widthwise of the third and fourth reinforcing walls,

fitting the fitting portion of said other liner component into the internally enlarged groove of said one liner component, and engaging the engaging portions of the two liner components with each other to bring the peripheral walls of the two liner components into contact with each other, and

placing from outside a probe of a friction agitation joining tool into a joint between the peripheral wall of the first liner component and the peripheral wall of the second liner component so as to position the probe partly in both the peripheral walls, and thereafter moving the probe relative to the two liner components to move the probe over the entire circumference

of the peripheral walls of the two liner components and join the peripheral walls of the two liner components to each other, an inner peripheral surface of said one liner component defining the internally enlarged groove thereof and the fitting portion of said other liner component to each other and the engaging portions of the two liner components to each other by friction agitation.

11. A process for fabricating a pressure vessel liner according to claim 6 comprising:

preparing a first liner component of aluminum comprising a tubular peripheral wall and a plurality of reinforcing walls inwardly extending from the peripheral wall and joined to one another, and a second liner component of aluminum comprising a peripheral wall generally in the form of a bowl and a plurality of reinforcing walls provided inside the peripheral wall and corresponding to the respective reinforcing walls of the first liner component,

forming an internally enlarged groove in an end face of each of the reinforcing walls of each liner component and in an end face of the peripheral wall thereof, the internally enlarged groove extending longitudinally of the end face of each reinforcing wall and having an end opening in an outer surface of the peripheral wall thereof,

preparing connecting members each fittable into both the internally enlarged groove of the first liner component and the internally enlarged groove of the second liner component and having an aluminum outer portion,

butting the peripheral wall and the reinforcing walls of

the first liner component against the peripheral wall and the reinforcing walls of the second liner component respectively end-to-end, and fitting the connecting members respectively into the internally enlarged grooves of the first liner component and the internally enlarged grooves of the second liner component across the butted end faces thereof, and

placing from outside a probe of a friction agitation joining tool into a joint between the peripheral wall of the first liner component and the peripheral wall of the second liner component so as to position the probe partly in both the peripheral walls, and thereafter moving the probe relative to the two liner components to move the probe over the entire circumference of the peripheral walls of the two liner components and join the peripheral walls of the two liner components to each other, and the two liner components to the connecting members by friction agitation.

12. A process for fabricating a pressure vessel liner according to claim 8 comprising:

preparing a first liner component of aluminum comprising a tubular peripheral wall, two reinforcing walls inwardly extending from the peripheral wall toward a center line and joined to each other on the center line, the two reinforcing walls being positioned in a plane, and at least one reinforcing wall inwardly extending from the peripheral wall and joined to the two reinforcing walls, and a second liner component of aluminum comprising a peripheral wall generally in the form of a bowl, and a plurality of reinforcing walls provided inside the peripheral wall and corresponding respectively to the

reinforcing walls of the first liner component,

forming an internally enlarged groove in end faces of the two reinforcing walls of one of the first and second liner components which walls are positioned in the same plane and in an end face of the peripheral wall thereof, the internally enlarged groove extending in the end faces of the two reinforcing walls longitudinally of the end faces and having opposite end openings in an outer surface of the peripheral wall, and providing a fitting portion on ends of the two reinforcing walls of the other of the first and second liner components which walls are positioned in the same plane and on an end of the peripheral wall thereof, the fitting portion being fittable into the internally enlarged groove of said one liner component,

forming an internally enlarged groove in an end face of the other reinforcing wall of each of the first and second liner components and in the end face of the peripheral wall thereof, the internally enlarged groove extending in the end face of said other reinforcing wall longitudinally of the end face and having an end opening in the outer surface of the peripheral wall,

preparing a connecting member at least having an outer end portion of aluminum and fittable into both the internally enlarged groove in said other reinforcing wall of the first liner component and the internally enlarged groove in said other reinforcing wall of the second liner component,

fitting the fitting portion on the two reinforcing walls of said other liner component positioned in the same plane

and on the peripheral wall into the internally enlarged groove in the two reinforcing walls of said one liner component positioned in the same plane and in the peripheral wall, butting the peripheral wall and the reinforcing walls of the first liner component against the peripheral wall and the reinforcing walls of the second liner component respectively end-to-end, and fitting the connecting member into both the internally enlarged groove of said other reinforcing wall of the first liner component and of the peripheral wall thereof and the internally enlarged groove of said other reinforcing wall of the second liner component and of the peripheral wall thereof across the butted end faces of the walls, and

placing from outside a probe of a friction agitation joining tool into a joint between the peripheral wall of the first liner component and the peripheral wall of the second liner component so as to position the probe partly in both the peripheral walls, and thereafter moving the probe relative to the two liner components to move the probe over the entire circumference of the peripheral walls of the two liner components and join the peripheral walls of the two liner components to each other, and the two liner components to the connecting member by friction agitation.

13. A pressure vessel comprising a pressure vessel liner according to claim 1, 2 or 3 which is covered with a fiber reinforced resin layer over an outer peripheral surface thereof.

14. A fuel cell system comprising a fuel hydrogen pressure vessel, a fuel cell and pressure piping for delivering fuel hydrogen gas from the pressure vessel to the fuel cell

therethrough, the fuel hydrogen pressure vessel comprising a pressure vessel according to claim 13.

15. A fuel cell motor vehicle having installed therein a fuel cell system according to claim 14.

16. Cogeneration system comprising a fuel cell system according to claim 14.

17. A natural gas supply system comprising a natural gas pressure vessel and pressure piping for delivering natural gas from the pressure vessel therethrough, the natural gas pressure vessel being a pressure vessel according to claim 13.

18. A cogeneration system comprising a natural gas supply system according to claim 17, a generator and a generator drive device.

19. A natural gas motor vehicle comprising a natural gas supply system according to claim 17 and an engine for use with natural gas as a fuel.

20. An oxygen gas supply system comprising an oxygen pressure vessel and pressure piping for delivering oxygen gas from the pressure vessel therethrough, the oxygen pressure vessel being a pressure vessel according to claim 13.